

Preparation of Fine Particulate Emissions Inventories

Chapter 7 – Fugitive Dust Area Sources



AGRICULTURAL TILLING Overview

- SCC
 - 2801000003
- Pollutants
 - Filterable PM_{10} , $PM_{2.5}$

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AGRICULTURAL TILLING NEI Method

- Activity Data (no. of acres of land tilled)
 - 1998 County-Level Activity Data
 - Acres of crops tilled in each county by crop type and by tilling method obtained from CTIC
 - Five tilling methods include:
 - no till
 - mulch till
 - ridge till
 - 0 to 15 percent residue
 - 15 to 30 percent residue

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AGRICULTURAL TILLING NEI Method (cont.)

- Emission Factor (mass of TSP per acre tilled)
 - Emission factor comprises:
 - Constant of 4.8 lbs/acre pass
 - Silt content of the surface soil
 - Number of tillings per year (conservation and conventional use)
 - Particle size multiplier for PM₁₀ and PM_{2.5}

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AGRICULTURAL TILLING NEI Method (cont.)

- Emission Factor (cont.)
 - Silt content

Soil Type	Silt Content (%)
Silt Loam	52
Sandy Loam	33
Sand	12
Loamy Sand	12
Clay	29
Clay Loam	29
Organic Material	10-82
Loam	40
 - Soil types assigned to counties by comparing USDA surface soil and county maps

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AGRICULTURAL TILLING NEI Method (cont.)

- Emission Factor (cont.)
 - Number of Tillings

Crop	Conservation Use	Conventional Use
Corn	2	6
Spring Wheat	1	4
Rice	5	5
Fall-Seeded Small Grain	3	5
Soybeans	1	6
Cotton	5	8
Sorghum	1	6
Forage	3	3
Permanent Pasture	1	1
Other Crops	3	3
Fallow	1	1

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AGRICULTURAL TILLING NEI Method (cont.)

■ Emission Calculation

$$E = c * k * s^{0.6} * p * a$$

- where: E = PM emissions, lbs per year
c = constant 4.8 lbs/acre-pass
k = dimensionless particle size multiplier ($PM_{10} = 0.21$;
 $PM_{2.5} = 0.042$)
s = silt content of surface soil, defined as the mass
fraction of particles smaller than 75 μm diameter
found in soil to a depth of 10 cm (%)
p = number of passes or tillings in a year
a = acres of land tilled

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AGRICULTURAL TILLING NEI Method (cont.)

- Emission equation used for years prior to 1999
- For 1999/2002, number of acres tilled for each of the five tillage types was estimated based on linear interpolation of national-level data available for 1998 and 1999/2002
- Developed national growth factors by tillage type for 1999/2002, using 1998 as basis
- Growth factors applied to county level emissions for 1998 to estimate county level emissions for 1999/2002
- Assumed no controls

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AGRICULTURAL TILLING Improving the NEI

- Use crop-specific acreage and tilling practice data from state/local agencies
- Use state/local emission factors
- Perform field study to determine local silt content percentage of surface soil
- Crop Calendars: Develop using state/local data to determine time and frequency of activities (e.g., land prep., planting, and tilling)

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California Air Resources Board (CARB) Study

■ Reference

- *Computing Agricultural PM₁₀ Fugitive Dust Emissions Using Process Specific Emission Rates and GIS*, Patrick Gaffney and Hong Yu, CARB
- Presented at 12th International Emission Inventory Conference, San Diego, CA, April 29 May 1, 2003
- Paper and slides available in PDF files:
<http://www.epa.gov/ttn/chief/conference/ei12/index.html>

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CARB Study (cont.)

- Statewide PM₁₀ EI for:
 - Land preparation activities
 - Harvest activities
- Goals:
 - Obtain current, crop-specific acreage data
 - Develop crop-specific temporal profiles (crop calendars)
 - Develop emission factors for all crops

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CARB Study (cont.)

- Crop-specific Acreage Data
 - County-level data from CA Dept. of Food and Agriculture
 - Data generated annually by crop and by county
 - Includes over 200 crops and 30 million acres

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CARB Study (cont.)

- Crop Calendars
 - Developed for 20 most important crop types
 - Importance based on acreage and potential emissions
 - Define temporal periods of farming operation activities by crop type

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Example Crop Calendar for Corn

Farming Operations	Crop Cycles Per Year	Passes Per Crop Cycle	Fraction of Acreage Per Cycle	Passes During Month											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land Preparation	1	1	1.0												
Shallow Disc	1	1	1.0												
Finish Disc	1	1	1.0												
Plant & Fertilize	1	1	1.0												
Weed Etc.	1	1	1.0												
Planting	1	1	1.0												
Cultivation	1	2	1.0												
Harvesting	1	1	1.0												

(Reference: Computing Agricultural PM_{10} Fugitive Dust Emissions Using Process Specific Emission Rates and GIS, prepared by Patrick Gaffney and Hong Yu from California Air Resources Board for U.S. EPA 2003 Annual Emission Inventory Conference.)

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CARB Study (cont.)

- Emission Factors (EFs)
 - Previous EFs:
 - Land Preparation: AP-42 Tilling factor (4.0 (lbs PM_{10} /acre-pass) applied to all operations
 - Harvesting: Estimated for only 3 crop types for which EFs were available
 - Improvements:
 - Conducted field testing to develop EFs for more operations
 - Crop & operation specific (for crop calendars)

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CARB Study (cont.)

Land Preparation Emission Factors

(lbs PM₁₀/acre-pass)

Root Cutting	0.3
Discing, Tilling, Chiseling	1.2
Ripping, Subsoiling	4.6
Land Planning & Floating	12.5
Weeding	0.8

- EFs used as surrogates for other land prep. operations

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CARB Study (cont.)

Harvest Emission Factors

(lbs PM₁₀/acre-pass)

Cotton Harvest	3.4
Almond Harvest	40.8
Wheat Harvest	5

- Assigned to over 200 crop types and adjusted using a "division factor" based on consultation with agricultural industry

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PAVED ROADS Overview

- SCC: 2294000000
- Pollutants
 - PM₁₀, PM_{2.5}

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Preparation of Fine Particulate Emissions Inventories

PAVED ROADS

NEI Method

- Activity Data [vehicle miles traveled (VMT) on paved roads]

- State-Level Activity Data

*State/road type level VMT from paved roads =
Total State/road type-level VMT - State/road type-level unpaved
road VMT*

- Because of differences in methodology between the calculation of total and unpaved VMT, there may be cases where unpaved VMT is higher than total VMT
- In these cases, unpaved VMT is reduced to total VMT, and paved road VMT is assigned a value of zero

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Preparation of Fine Particulate Emissions Inventories

PAVED ROADS

NEI Method (cont.)

- Activity Data [vehicle miles traveled (VMT) on paved roads] (cont.)

- Paved road VMT temporally allocated by month using NAPAP temporal allocation factors for total VMT.

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Preparation of Fine Particulate Emissions Inventories

PAVED ROADS

NEI Method (cont.)

- Emission Factor

- Empirical emission factor equation from AP-42

$$PAVED = PSDPVD * (PVSILT/2)^{0.65} * (WEIGHT/3)^{1.5} - C$$

where: PAVED = paved road dust emission factor for all vehicle classes combined (grams per mile)
PSDPVD = constant for particles of less than 10 microns in diameter (7.3 g/mi for PM₁₀)
PVSILT = road surface silt loading (g/m²)
WEIGHT = average weight of all vehicle types combined (tons)
C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear

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Preparation of Fine Particulate Emissions Inventories

PAVED ROADS

NEI Method (cont.)

- Emission Factor (cont.)
 - Paved road silt loadings assigned to each of the twelve functional roadway classifications
 - Road types with average daily traffic volume (ADTV) < 5,000 vehicles per day = 0.20 g/m²
 - Freeways = 0.015 g/m²
 - See AP-42, Section 13.2.1 for more information
 - AP-42 emission factors for paved roads only apply to reentrained dust
 - Use MOBILE model for estimating PM from tailpipe exhaust, brake wear, and tire wear.

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Preparation of Fine Particulate Emissions Inventories

PAVED ROADS

NEI Method (cont.)

- Emission Factor (cont.)
 - Adjustments for precipitation
 - Emission factor multiplied by a rain correction factor, calculated as follows:
- $$(365 - p * 12 * 0.5) / 365$$
- where: p = the number of days in a given month with greater than 0.01 inches of precipitation
- Precipitation data used in the paved road emission factor calculations were taken from stations representative of urban areas in each state
 - Final emission factors developed by month at the State and road type level for the average vehicle fleet

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PAVED ROADS

NEI Method (cont.)

- Emission Calculation

$$EM_{s,r,m} = VMT_{s,r,m} * EF_{s,r,m}$$

where: EM = PM_{10} emissions, tons per month
 VMT = VMT , miles per month
 EF = tons per mile
 M = month
 S = State
 R = road type class

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$PM_{2.5} = PM_{10} \text{ emissions} \times 0.25$

PAVED ROADS

NEI Method (cont.)

- Allocation of State Emissions to County Level
 - Paved road emissions are allocated to the county level according to the fraction of total State VMT in each county for the specific road type

$$PVDEMIS_{X,Y} = PVDEMIS_{ST,Y} * VMT_{X,Y} / VMT_{ST,Y}$$

where: $PVDEMIS_{X,Y}$ = paved road PM emissions (tons) for county x and road type y
 $PVDEMIS_{ST,Y}$ = paved road PM emissions (tons) for the entire State for road type y
 $VMT_{X,Y}$ = total VMT (million miles) in county x and road type y
 $VMT_{ST,Y}$ = total VMT (million miles) in entire State for road type y

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Preparation of Fine Particulate Emissions Inventories

PAVED ROADS

NEI Method (cont.)

- Controls
 - Control efficiency of 79 percent applied to:
 - Urban and rural roads in serious PM NAAs; and
 - Urban roads in moderate PM NAAs
 - Corresponds to vacuum sweeping on paved roads twice per month
 - Rule penetration varies by road type and NAA classification (serious or moderate)

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Preparation of Fine Particulate Emissions Inventories

PAVED ROADS

Improvements to NEI Method

- VMT on paved roads for local area
(Source: State Dept. of Transportation, Mobile Source Section of Environmental Dept)
- Local registration data representing the average weight of vehicles (since this variable is weighted most heavily)
(Source: State Dept. of Motor Vehicles, Mobile Source Section of Environmental Dept)

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PAVED ROADS

Improvements to NEI Method (cont.)

- Perform sampling to refine value used for silt content
 - Only consider if you can collect enough samples to give a good representation of roads in your area
- Obtain and use local precipitation values

(Source: National Weather Bureau)

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Preparation of Fine Particulate Emissions Inventories

UNPAVED ROADS

Overview

- SCC 2296000000
- PM10-PRI/FIL and PM2.5-PRI/FIL
- No condensible material, so:
PM-PRI = PM-FIL

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Preparation of Fine Particulate Emissions Inventories

UNPAVED ROADS

NEI Method

- Activity
 - State level VMT from U.S. DOT, Federal Highway Administration allocated to counties by population
 - Activity Data (VMT on unpaved roads)
 - State-level activity for urban and rural local functional classes

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Preparation of Fine Particulate Emissions Inventories

UNPAVED ROADS NEI Method (cont.)

$$\text{Unpaved VMT}_{\text{Roadtype}} = \text{Mileage}_{\text{Roadtype}} * \text{ADTV} * \text{DPY}$$

Where:

Unpaved VMT = road type specific unpaved VMT (miles/year)

Mileage = total number of miles of unpaved roads by functional class (miles)

ADTV = Average daily traffic volume (vehicle/day)

DPY = number of days per year

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UNPAVED ROADS NEI Method (cont.)

- Non-local functional classes including:
 - Rural minor collector, rural major collector, rural minor arterial, rural other principal arterial, urban collector, urban minor arterial, and urban other principal arterial
 - ADTV not available for non-local roads, estimated from local urban and rural VMT and mileage

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Preparation of Fine Particulate Emissions Inventories

UNPAVED ROADS NEI Method (cont.)

$$\text{ADTV} = \text{VMT} / \text{Mileage}$$

Where:

ADTV = average daily traffic volume for State and federally maintained roadways

VMT = urban/rural VMT on county-maintained roadways (miles/year)

MILEAGE = urban/rural state-level roadway mileage of county-maintained roadways (miles)

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UNPAVED ROADS NEI Method (cont.)

- Add Non-local functional class VMT to local functional class VMT to determine State total unpaved VMT by road type
- Unpaved road VMT temporally allocated by month using NAPAP temporal allocation factors for total VMT

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UNPAVED ROADS NEI Method (cont.)

- Emission Factor
 - AP-42 emission factor equation

$$EF = [k \cdot (s/12) \cdot (S/30)^{0.5}] / [(M/0.5)^{0.2}] - C$$

Where:

- EF = size specific emission factor (pounds per VMT)
- k = empirical constant (1.8 lb/VMT for PM10-PR1, 0.27 for PM2.5-PR1)
- s = surface material silt content (%)
- M = surface material moisture content (%)
- S = mean vehicle speed (mph)
- C = emission factor for 1980's vehicle fleet exhaust, brake wear, and tire wear

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UNPAVED ROADS NEI Method (cont.)

- NEI Default Emission Factor Input Values
 - Surface material silt content(s)
 - Average state-level values developed available at http://ftp.epa.gov/EmissionInventory/finalnei99ver2/criteria/documentation/xtra_sources/
 - Mean vehicle weight (W)
 - National average value of 2.2 tons (based on typical vehicle mix)
 - Surface material moisture content (M_{dry})
 - 1 percent

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UNPAVED ROADS

NEI Method (cont.)

- NEI Default Emission Factor Input Values (cont.)
 - Number of days exceeding 0.01 inches of precipitation (p)
 - Precipitation data from one meteorological station in state used to represent all rural areas of the state
 - Local climatological data available from National Climatic Data Center at <http://www.ncdc.noaa.gov/oa/ncdc.html>

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UNPAVED ROADS

Improvements to NEI

- Summary
 - Review NEI defaults for representativeness
 - Use local data when possible for activity and emission factor inputs
 - If resources are limited, focus on collecting data for:
 - Local precipitation data
 - Local VMT estimates

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UNPAVED ROADS

Case Study - Overview

- Case Study: County level emissions inventory for unpaved roads
 - See Case Study Number 7-1

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UNPAVED ROADS

Case Study - Solution

- Case Study: County level emissions inventory for unpaved roads
 - See Handout 7-1

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CONSTRUCTION

Overview

- SCCs:
 - Residential - 2311010000
 - Commercial - 2311020000
 - Road - 2311030000
- PM10-PRI/FIL and PM2.5-PRI/FIL
 - No condensibles, so PM-PRI = PM-FIL
- 1999 PM2.5-PRI NEI
 - Res - 5%
 - Comm - 40%
 - Road - 55%

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION

NEI Method

- Activity Data: Number of acres disturbed per year
- Estimated using housing start data
 - Total no. of regional monthly housing unit starts (HS)
 - National monthly housing unit starts available for:
 - 1-unit housing
 - 2-unit housing
 - 3-4 unit housing
 - 5+ unit housing

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- Regional housing unit starts by housing category estimated as follows:

$$\text{Reg. HS by Category} = \text{Total Reg. HS} \times \frac{\text{National HS by Category}}{\text{Total National HS}}$$

(Reference: *Housing Starts Report, 1999*, U.S. Department of Commerce, Bureau of the Census, Manufacturing and Construction Division, Residential Construction Branch.)

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- Monthly regional housing starts by housing category summed to obtain an annual total
- County Activity
 - Annual no. of building permits in each county for:
 - Housing structures with 1-unit
 - Housing structures with 2-units
 - Housing structures with 3-4 housing units
 - Housing structures with 5+ units

(Reference: *Building Permits Survey, 1999*, U.S. Department of Commerce, Bureau of the Census, Manufacturing and Construction Division, Residential Construction Branch.)

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- Regional no. of residential *structure* starts based on the reported no. of housing unit starts:
 - No. of 1-unit housing units = no. of 1-unit housing structures
 - No. of 2 unit housing units divided by 2 units per structure
 - No. of 3-4 unit housing units divided by 3.5 units per structure
 - No. of 5+ unit housing units divided by region-specific units per structure as calculated from building permits data

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- Estimate county no. of residential structure starts by housing category as follows:

$$\text{County Structure Starts} = \text{Regional Structure Starts} \times \frac{\text{County Bldg Permits}}{\text{Regional Bldg Permits}}$$

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- Estimated acres disturbed from county no. of structures:

- 1-unit structures: 1/4 acre per building
- 2-unit structures: 1/3 acre per building
- Apartments: 1/2 acre per building

- Estimated duration of construction:

- 1-unit structures: 6 months
- 2-unit structures: 6 months
- Apartments: 12 months

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- Estimate no. of apartment structures by adding the no. of 3-4 unit buildings and of 5+ unit buildings
- Estimate no. of 1-unit houses with and without basements
 - Multiply regional no. of 1-unit structures by regional percentage of one-family houses with basements and subtract product from total no. of 1-unit houses to estimate 1-unit houses w/out basements

(Reference: *Characteristics of New Houses - Table 9. Type of Foundation by Category of House and Location, 1998, U.S. Department of Commerce, Bureau of the Census.*)

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- For 1-Unit Housing with Basements
 - Estimate cubic yards of dirt moved per house
 - Multiply assumed 2,000 square feet per structure by assumed average basement depth of 8 feet
 - Add-in 10 percent of above cubic yard estimate to account for footings and other backfilled areas adjacent to basement

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- 1-Unit Housing with Basements
 - PM10-PRI: 0.011 tons/acre/month plus 0.059 tons/1000 cubic yards of on-site cut/fill
- 1-Unit Housing without Basements and all 2-Unit Housing
 - PM10-PRI: 0.032 tons/acre/month
- Apartments
 - PM10-PRI: 0.11 tons/acre/month
- PM2.5-PRI = 0.2 * PM10-PRI

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- 1-Unit Structures with Basements

$$\text{Emissions} = (0.011 \text{ tons } PM_{10}/\text{acre}/\text{month}) \times B \times f \times m) + 0.059 \text{ tons } PM_{10}/1000 \text{ yards}^3 \text{ of cut/fill})$$

where: B = no. of housing starts with basements;
 f = buildings-to-acres conversion factor (1/4 acre per building);
 m = duration of construction activity in months.

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- 1-Unit Structures without Basements, All 2 Structures, and Apartments

$$\text{Emissions} = (0.032 \text{ tons PM}_{10}/\text{acre/month}) \times B \times f \times m$$

where: B = no. of housing starts without basements;
 f = buildings-to-acres conversion factor; and
 m = duration of construction activity in months

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Method (cont.)

- Apply a control efficiency of 50 percent for both PM₁₀-PRI and PM₂₅-PRI emissions for PM-10 NAAs; all other areas 0 percent
- Control efficiency represents Best Available Control Method (BACM) controls on fugitive dust construction activities in these counties

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Correction Parameters

- Applied to final emissions for all 3 construction categories
- Soil Moisture Level

$$\text{Moisture Level Corrected Emissions} = \text{Base Emissions} \times (24/\text{PE})$$

where: PE = Precipitation-Evaporation value for county

- Compiled statewide average Precipitation-Evaporation (PE) values according to Thornthwaite's PE Index

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION NEI Correction Parameters

- Silt Content

Silt Content Corrected Emissions = Base Emissions x (s/9%)

where: s = % dry silt content in soil for area being inventoried

- County-specific dry silt values are applied to PM10-PRI emissions for each county

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION Improvements to NEI

- Obtain local data for new construction housing starts, permits for additions/modifications to existing homes

Source: State Housing Agency or Real Estate Association

- Develop a building to acres conversion factor for acres disturbed per construction unit
- Obtain information on seasonality of residential construction practices
- Obtain local information on soil moisture content, silt content, and control efficiency

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION Case Study - Overview

- Case Study: County level emissions inventory for residential construction
 - See Case Study Number 7-2

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Preparation of Fine Particulate Emissions Inventories

RESIDENTIAL CONSTRUCTION

Case Study - Solution

- Case Study: County level emissions inventory for residential construction
 - See Handout 7-2

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Preparation of Fine Particulate Emissions Inventories

COMMERCIAL CONSTRUCTION

NEI Method

- Activity data: No. of acres disturbed per year
- National-Level Activity
 - Dollar Value of Construction Put in Place, 1999
 - National data allocated to Counties

(Reference: Table 1. Annual Value of Construction Put in Place in the United States for Nonresidential buildings: 1996 - 2000, Millions of constant dollars, U.S. Department of Commerce, Bureau of the Census.)

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Preparation of Fine Particulate Emissions Inventories

COMMERCIAL CONSTRUCTION

NEI Method (cont.)

- Allocation of National Data to Counties
 - National level activity allocated to counties using 2 data sources:
 - Annual Average Employment for SIC 154, Data Series ES202, Bureau of Labor Statistics, 1999
 - Annual Average Employment for SIC 154, MarketPlace 3.0, Dun & Bradstreet, 1999
 - Applied Dun & Bradstreet county proportion of the State total to the BLS State total to estimate employment for counties where data were withheld

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Preparation of Fine Particulate Emissions Inventories

COMMERCIAL CONSTRUCTION NEI Method (cont.)

- Activity Data Conversion
 - Converted dollar value to acres disturbed using a conversion factor of 1.6 acres/10⁶ dollars applied to the estimated county-level construction valuation data

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COMMERCIAL CONSTRUCTION NEI Emission Calculations

- PM10-PRI Emission Factor = 0.19 tons/acre/month
- PM2.5-PRI = 0.2 * PM10-PRI

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Preparation of Fine Particulate Emissions Inventories

COMMERCIAL CONSTRUCTION NEI Emission Calculations (cont.)

- Emission formula for calculating the emissions is:

$$\text{Emissions} = (0.19 \text{ tons/acre/month}) \times \$ \times f \times m$$

where: \$ = dollars spent on nonresidential construction in millions
f = dollars-to-acres conversion factor
m = duration of construction activity in months (assumed 11 months)

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Preparation of Fine Particulate Emissions Inventories

COMMERCIAL CONSTRUCTION *Improvements to NEI*

- Obtain local information on number of acres disturbed per construction event or per construction dollars spent

Source: Construction Industry Association

- Obtain information on location, average duration, and seasonality of commercial construction practices
- Obtain local information on soil moisture content, silt content, and control efficiency

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Preparation of Fine Particulate Emissions Inventories

ROAD CONSTRUCTION *NEI Method*

- Activity data: Number of acres disturbed
- State-Level Activity
 - Obtained State expenditure data for capital outlay for six classifications
 - Interstate, urban
 - Interstate, rural
 - Other arterial, urban
 - Other arterial, rural
 - Collectors, urban
 - Collectors, rural

(Reference: Highway Statistics, Section IV - Finance, Table SF-12A, "State Highway Agency Capital Outlay - 1999." Federal Highway Administration.)

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ROAD CONSTRUCTION *NEI Method (cont.)*

- State-Level Activity (Continued)
 - Expenditures include all improvement types except for:
 - Minor widening
 - Resurfacing
 - Bridge rehabilitation
 - Safety
 - Traffic operation and control
 - Environmental enhancement and other

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ROAD CONSTRUCTION

NEI Method (cont.)

- Estimate miles of new road constructed
 - \$4 million/mile for interstate roads
 - \$1.9 million/mile for other arterial and collector roads

(Reference: Personal Communication with North Carolina Department of Transportation)

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ROAD CONSTRUCTION

NEI Method (cont.)

- Estimate acres for each road type using estimates of acres disturbed per mile:
 - Interstate, urban and rural; Other arterial, urban - 15.2 acres/mile
 - Other arterial, rural - 12.7 acres/mile
 - Collectors, urban - 9.8 acres/mile
 - Collectors, rural - 7.9 acres/mile

(Reference: *Estimating Particulate Matter Emissions from Construction Operations*, prepared by Midwest Research Institute for U.S. Environmental Protection Agency, 1999.)

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ROAD CONSTRUCTION

NEI Method (cont.)

- Sum across road types to yield state total of acres disturbed
- Activity Data Allocation to Counties
 - Distributed state-level estimates of acres disturbed to counties according to housing starts
 - see residential construction for description of development of county-level housing start data

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Preparation of Fine Particulate Emissions Inventories

ROAD CONSTRUCTION NEI Emission Calculations

- PM10-PRI Emission Factor =
0.42 tons/acre/month
- PM2.5-PRI = 0.2 * PM10-PRI

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ROAD CONSTRUCTION NEI Emission Calculations (cont.)

- The formula for calculating emissions is:

$$\text{Emissions} = (0.42 \text{ tons PM}_{10}/\text{acre}/\text{month}) \times \$ \times f1 \times f2 \times d$$

where: \$ = State expenditures for capital outlay on road construction

f1 = \$-to-miles conversion factor

f2 = miles-to-acres conversion factor

d = duration of roadway construction activity in months (assumed 12 months)

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Preparation of Fine Particulate Emissions Inventories

ROAD CONSTRUCTION Improvements to NEI

- Obtain information on location and timing of road construction practices in area

(Source: State Department of Transportation)

- Obtain local data on the number of miles constructed and the number of acres disturbed per project or per mile of road constructed

- Obtain local estimate for duration of projects

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Preparation of Fine Particulate Emissions Inventories

ROAD CONSTRUCTION Improvements to NEI (cont.)

- Obtain information on private road construction activity
(Source: Construction Industry Association)
- Obtain local information on soil moisture content, silt content, and control efficiency

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Preparation of Fine Particulate Emissions Inventories

ROAD CONSTRUCTION Case Study - Overview

- Case Study: County level emissions inventory for road construction activities
 - See Case Study Number 7-3

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ROAD CONSTRUCTION Case Study -Solution

- Case Study: County level emissions inventory for road construction activities
 - See Handout 7-3

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